

FRONT-OPENING UNIFIED POD AUTO-LOADING  
STRUCTURE

BACKGROUND OF THE INVENTION

Field of the Invention:

5 The present invention relates to a FOUP (front-opening unified pod) auto-loading structure and, more particularly, to ~~asuch~~ FOUP auto-loading structure, which is suitable for use in the ~~loading-in-interface port ofin~~ a wafer manufacturing ~~process~~equipment to automatically close/open the cover of a  
10 FOUP.

Brief Description of the Prior Art:

Current wafer process puts ~~In the fabrication of wafers,~~ wafers ~~are put in~~ a unified pod such that, ~~and~~ the purity of the small inner ~~inside space~~ of the unified pod is well controlled.

15 Because the purity of the small inner~~inside space~~ of the unified pod is well controlled, the purity of the external ~~cleaning room~~ is less critical. This ~~measure~~ saves much clean expenditure on the wafer manufacturing ~~equipment cleaning cost~~. However, external dust or human body dust may be carried in the manufacturing  
20 equipment when opening the cover of the unified pod manually, so as to ~~causing bring about~~ a contamination to wafers.

SUMMARY OF THE INVENTION

The invention has been accomplished to provide a FOUP

auto-loading structure, which eliminates the ~~cited~~aforsaid problem. It is ~~anthe main~~ object of the present invention to provide a FOUP auto-loading structure, which automatically loads the FOUP for ~~in and opening or s/closing~~es its coverthe FOUP, 5 thereby preventing a wafers from contamination to wafers. It is another object of the present invention to provide a FOUP auto-loading structure, which can be~~forms~~ a part of ~~the automation of the~~an full-automated wafer manufacturing process.

To achieve the ~~aforsaid~~ objects and according to one 10 aspect of the present invention, the FOUP auto-loading structure ~~of the present invention~~ comprises a machine base, a carrier, a sliding control mechanism, a latch mechanism, a horizontal shifting mechanism and a lifting mechanism. ~~t~~The machine base ~~with an upper access has comprising~~ a backboard with an upper 15 access, a table ~~againston the middle of the backboard~~ward, and a base against ~~at a bottom side of the backboard,~~ the backboard ~~having an access on an upper side of the backboard;~~ a The carrier ~~earriage supported by on the table is and~~ adapted to carry a FOUP, ~~t~~The carrier ~~hasearriage having~~ an elongated opening 20 close by the backboard~~hole through top and bottom sidewalls thereof;~~ a The sliding control mechanism is mounted on the table to support the carrierearriage and ~~controlled it to move the earriage on the table toward or away from the access;~~ a clamp~~The~~

~~latch mechanism below the carrier has mounted on the bottom~~  
~~sidewall of the carriage, the clamp mechanism comprising a rail~~  
~~fixedly fastened onto the bottom thereofsidewall of the carriage, a~~  
~~screw rodthreaded rod~~ disposed in parallel to the rail of the  
5 ~~elamplatch mechanism~~, a sliding pade threaded onto the ~~screw~~  
~~rodthreaded rod~~ of the ~~elamplatch mechanism~~ and adapted to  
~~slidemove~~ along the rail of the ~~elamplatch mechanism~~ upon rotary  
~~motion of the screw rod of the clamp mechanism~~, a motor adapted  
to rotate the ~~screw rodthreaded rod~~ of the ~~elamplatch mechanism~~  
10 clockwise/counter-clockwise so as to make the sliding pad slide  
forwardly and backwardly, and a ~~elamplatchlocking~~ plate fixedly  
mounted on the sliding pade of the ~~elamplatch mechanism~~ and  
adapted to latch the FOUP on the carrier by insertinged through  
the elongated openinghole of the ~~carriagecarrier~~ and adapted to be  
15 ~~movinged to a retaining portion of the carrier~~ with the sliding pade  
of the ~~elamplatch~~ to a retaining portion of the carrier ~~mechanism~~  
to clamp the FOUP being carried on the carriage.\_\_\_\_; a  
~~horizontal shifting mechanism, t~~The horizontal shifting mechanism  
has a comprising-rail means fixedly mounted on the base of the  
20 machine base, a horizontal ~~screw rodthreaded rod~~ disposed in  
parallel to the rail ~~means~~ of the horizontal shifting mechanism, a  
platform threaded onto the ~~screw rodthreaded rod~~ of the horizontal  
shifting mechanism, and a motor to drive and control the platform

to move horizontally along the rail of the horizontal shifting mechanism as ~~clockwise/counter-clockwise rotating controlled to rotate the screw rod~~ threaded rod of the horizontal shifting mechanism clockwise/counter-clockwise, thereby moving for  
5 causing the platform to be moved horizontally along the rail means of the horizontal shifting mechanism toward/away from the backboard of the machine base; and a lifting mechanism, ~~t~~ The lifting mechanism ~~has~~ comprising a motor and a ~~screw rod~~ threaded rod and slider set vertically mounted on the platform of the  
10 horizontal shifting mechanism; ~~t~~ The ~~screw rod~~ threaded rod and slider set ~~comprising~~ has a vertical rail, a ~~screw rod~~ threaded rod longitudinally mounted in the vertical rail, a sliding ~~pade~~ threaded onto the ~~screw rod~~ threaded rod of the lifting mechanism and moved along the vertical rail upon ~~the rotation~~ rotary motion of the  
15 ~~screw rod~~ threaded rod of the lifting mechanism. According to another aspect of the present invention, the FOUP auto-loading structure further comprises a ~~headstock gear~~ cover close/open control mechanism moved with the sliding ~~pade~~ of the lifting mechanism and controlled to close/open the cover of the FOUP  
20 being ~~carried~~ on the ~~carriage~~ carrier. According to still another aspect of the present invention, the ~~cover close/open control mechanism comprises~~ headstock gear has a gate, two racks, two support arms and a driving unit. ~~fitting and adapted to be~~ The

gate ~~moves~~ in and out of the access of the backboard of the machine base, ~~the gate having two through holes; The two racks are respectively fixedly fastened onto a surface back sidewall of the gate that does not contact the FOUP.~~ The two support arms  
5 ~~are respectively extended from the racks and connected to the sliding pade of the lifting mechanism;~~ and a ~~The driving unit mounted above the two racks on a back sidewall of the gate and controlled to close/open the cover of the FOUP being carried on the carriagecarrier, the driving unit has comprising~~ a transmission  
10 shaft, a motor controlled to rotate the transmission shaft, two rotary bolts respectively coupled to the transmission shaft and inserted through the through holes of said gate ~~and adapted for engaging into the lockating holes and for turning~~ rotating with by the transmission shaft to thus close/open the cover of the FOUP  
15 ~~being carried on the carriagecarrier.~~ According to still another aspect of the present invention, ~~carriage~~ the carrier has a round opening for inserting through a locking bolt engaging ~~ed with a locking bolt control motor to thus comprises an escape hole, a motor fixedly mounted on a bottom sidewall thereof, and a locking~~  
20 ~~bolt inserted through the escape hole and coupled to the motor at the carriage and rotated by the motor at the carriage to lock the FOUP on the carriagecarrier.~~

Other objects, advantages, and novel features of the

invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

5           FIG. 1 is a perspective view of a FOUP auto-loading structure according to the present invention.

FIG. 2A is an exploded view of a part of the present invention, showing the arrangement of the ~~elamplatch-mechanism~~, the locking bolt and locking bolt control motor, the sliding control  
10 mechanism, and the table.

FIG. 2B is a sectional view of a part of the present invention, showing the arrangement of the ~~elamplatch-mechanism~~, the locking bolt and locking bolt control motor, and the sliding control mechanism between the ~~earriage~~carrier and the table.

15           FIG. 3 is a perspective view of the lower part of the present invention, showing the arrangement of the horizontal shifting mechanism and the lifting mechanism.

FIG. 4 is a perspective backside view of a part of the present invention, showing the arrangement of the lifting  
20 mechanism, the horizontal shifting mechanism, and the ~~cover~~  
~~close/open-control-mechanism~~headstock gear.

FIG. 5 is a perspective view in an enlarged scale of the upper part of FIG. 4.

FIG. 6 is a schematic cross-section~~drawing~~ showing the operation of the present invention.

#### **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

Referring to FIG. 1, a typical FOUP (front-opening unified  
5 pod) 8 and an inventive FOUP auto-loading structure are shown,  
wherein the inventive structure is applied for automatically  
loading a cover 82 of the FOUP 8 and opening/closing the cover.  
In addition to the cover 82, the FOUP 8 also includes comprising  
an front-opening 81, closed by the cover 82~~a cover 82 that closes~~  
10 ~~the opening 81,~~ and a bottom plate~~panel~~ 83. The cover 82 has two  
~~locating~~ locking holes 821 and 821'. The bottom panel~~plate~~ 83  
~~has~~comprises a positioning portion~~hole~~ 831 at the center, and a  
retaining portion 832 at a side close by the cover~~at a front side.~~  
~~The invention is used to load and open/close the cover 82 of the~~  
15 ~~FOUP 8.~~

Referring to FIGS. 1 and 2, the inventive FOUP  
auto-loading structure includes a machine base 1, a carrier 2, a  
sliding control mechanism 21, a latch~~mechanism 4,~~ a horizontal  
shifting mechanism 5 and a lifting mechanism 6. The machine  
20 base, referenced by 1, ~~with an upper access 110~~ has~~comprises~~ a  
backboard 11 fixedly ~~fastened~~ disposed against~~to the loading port~~  
of the manufacturing equipment 9. ~~The back board 11 has~~ a table  
12 is transversely disposed against~~on the middle of the backboard~~

11, a base 13 fixedly ~~provided at the~~ disposed against bottom side thereof of the backboard 11, an access 110 disposed ~~at on the~~ upper side of the backboard 11 ~~above the table 12~~, two parallel sliding slots 111 and 112 longitudinally ~~vertically~~ disposed at the  
5 backboard 11 and below the table 12 (see also FIG. 4), and a ~~packing member~~ gasket 113 fastened ~~on edge to the border~~ of the access 110 ~~at the front side facing the FOUN 8~~ and adapted to ~~match with~~ accommodate the front opening 81 of the FOUN 8.

The earriage carrier, referenced by 2, ~~comprises has~~ three  
10 upright locating pin positioning rods 201 ~~disposed~~ corresponding to three positioning grooves 833 ~~at of~~ the bottom panelplate 83 of the ~~unified pod~~ FOUP 8 for the positioning of the FOUN 8 on the carrierage 2, two first upright ~~detecting on~~ pins 202 and 202' corresponding to two round recessed holes 834 and 834' ~~at on~~ the  
15 bottom panelplate 83 of the FOUN 8 for detecting the ~~a~~ front-endstage manufacturing process or rear-stage backend manufacturing process, two second upright ~~detecting on~~ pins 203 and 203' corresponding to detecting recesses inspection holes 835 and 835' ~~at on~~ the bottom panelplate 83 of the FOUN 8 for  
20 detecting if the a type of the unified pod FOUN 8 is a to be the 13-piece ~~unified pod~~ or 25-piece ~~unified pod~~, and a third upright detecting pin 206 (see FIG. 2B) to determine if the FOUN 8 is positioned correctly. If the FOUN 8 does not match the upright



detecting pins 201, 202 and 203', the bottom ~~panel~~plate 83 is tilted and cannot ~~force~~press down the third upright detecting pin 206. In this case, it means that the FOUP 8 is not correctly positioned. The carriage 2 further ~~comprises~~has an ~~escape hole~~a round opening 204, to accommodate a locking bolt 3 (described later) and an elongated ~~opening hole~~opening 205 to accommodate a locking plate 45 (described later).

FIG. 2A shows the ~~earriage~~carrier 2 supported ~~by~~on a sliding control mechanism 21 ~~above~~on the table 12. The sliding control mechanism 21 ~~comprises~~has two parallel rails 22 and 22' fixedly mounted on the table 12, a ~~front~~limit switch 221 and a ~~rear limit switch~~221' respectively disposed at ~~front and rear~~two ends of ~~one~~rail 22, two sliding pads 23 and 23' fixedly fastened ~~to the bottom side wall of~~mounted respectively on the parallel rails 22 and 22' of the ~~earriage~~carrier 2 ~~for movement and moved~~with the carriage along the rails 22 and 22', a ~~screw rod~~threaded rod 25 fixedly mounted ~~on~~in the table 12 below the sliding pad 23 close by the limit switches 221 and 221', and a reversible motor 24 adapted to rotate the ~~screw rod~~threaded rod 25 clockwise/counter-clockwise. ~~One~~The sliding pad 232 is threaded onto the ~~screw rod~~threaded rod 25. When starting the reversible motor 24 to rotate the ~~screw rod~~threaded rod 25 clockwise or counter-clockwise, the ~~earriage~~carrier 2 is moved

with the sliding pades 23 and 23' along the rails 22 and 22' toward or away from the access 110.

Referring to FIG. 2B and FIG. 2A again, a locking bolt control motor 31 and a elamplatch mechanism 4 are fixedly fastened to the bottom ~~sidewall~~ of the earriagecarrier 2. A locking bolt 3 is a T shape with a stem coupling to the locking bolt control motor 31 through limit switches 311, 311' and a head ~~is inserted~~ through the ~~escape hole~~round opening 204 of the earriagecarrier 2, ~~having a front end protruding over the top side of the carriage 2 for inserting into the positioning portion hole 831 of the bottom panelplate 83 of the FOUP 8 and a rear end coupled to the locking bolt 3. After inserting~~ the locking bolt 3 into the positioning portionhole 831 ~~of the bottom panelplate 83 of the FOUP 8 and a rear end coupled to the locking bolt 3. After inserting~~ of the locking bolt 3 into the positioning portionhole 831 ~~of the bottom panelplate 83 of the FOUP 8, the locking bolt control motor 31 is operated to rotate the locking bolt 3 by~~ through 90° angle to lock the FOUP 8. The ~~limit switches 311 and 311' are provided to control forward/backward turning operation of the motor 31 through to rotate clockwise or counterclockwise 90°. The front limit switch 221 and rear limit switch 221' control the locking bolt control motor 31 to rotate 90° forwards or backwards, so as to turn the unlock~~move the locking bolt 3 between the locking ~~position~~ and the unlocking positions.

The elamplatch mechanism 4 ~~comprises~~ has a rail 41, a

sliding pad 42, a motor 43, a threaded rod 44, the locking plate 45,  
limit switches 411, 411' and rollers 46. The rail 41 is fixedly  
fastened to the bottom of the latch 4 in parallel to the side wall of  
the carriage 2, a screw rod threaded rod 44 disposed in parallel to  
5 the rail 41, on which a slide 42 is disposed to threaded onto the  
screw rod threaded rod 44 and moved along the rail 41 with  
rotation of the upon rotary motion of the screw rod threaded rod  
44, a The front limit switches 411 and a rear limit switch 411'  
are respectively mounted on the front and rear two ends of the rail  
10 41, and a motor 43 is controlled to rotate the screw rod threaded  
rod 44, and a clamp The latch locking plate 45 is fixedly  
mounted on the sliding pad 42 and inserted through the elongated  
opening hole 205 of the carriage carrier 2 and adapted to clamp latch  
the retaining portion 832 of the bottom panel plate 83 of the FOUP  
15 8. Clockwise/counter-clockwise Rotation of the motor 43  
clockwise/counter-clockwise drives causes the clamp the  
locking latch plate 45 to be moved forwardly and backwardly with  
the sliding pad 42 forwards or backwards, and therefore the  
clamp locking latch plate 45 is pressed on or released from the  
20 retaining portion 832 of the bottom panel plate 83 of the FOUP 8.  
Further, the plastic rollers 46 are bilaterally provided disposed at  
the top side of the clamp locking latch plate 45, which in order to  
prevent damage to the retaining portion 832 from being damaged

~~as upon the retaining portion 832 presses down on ing of the~~  
~~elamplatehlocking plate 45 on the retaining portion 832, and~~  
~~eliminates the production of dust caused by due to friction~~  
~~between the retaining portion 832 and the elamplatehlocking plate~~  
5 45.

Referring to FIG. 3, a horizontal shifting mechanism 5 and  
a lifting mechanism 6 are respectively installed ~~overin~~ the base 13  
of the machine base 1. The horizontal shifting mechanism 5  
~~comprises has two parallel rails 51 and 51'— disposed respectively~~  
10 ~~on the base 13 of the machine base 1 horizontally arranged in~~  
~~parallel and extended perpendicular to the backboardward 11, a~~  
~~fronttwo limit switches 511 and a rear limit switch 511'~~  
~~respectively provided—disposed at the front and reartwo ends of~~  
~~one rail 51, a horizontal serew rodthreaded rod 53 disposed in~~  
15 ~~parallel above the elevation of and in parallel to the rails 51 and~~  
~~51', a platform 52 threaded onto by the serew rodthreaded rod 53~~  
~~and slidably movably supported byon the rails 51 and 51', and a~~  
~~motor drive 54 controlled to rotate the serew rodthreaded rod 53~~  
~~clockwise/counter-clockwise. Rotating the serew rodthreaded rod~~  
20 ~~53 clockwise/counter clockwise causes so as to move the platform~~  
~~52 to be moved horizontally forwardlys/backwardlys along the~~  
~~rails 51 and 51' relative to the backboard 11. The lifting~~  
~~mechanism 6 comprises has a serew rodthreaded rod and slider set~~

61 and an upright motor 65 ~~vertically~~ mounted on the platform 52 of the horizontal shifting mechanism 5. The ~~screw rod~~ threaded rod and slider set 61 ~~comprises~~ has a vertical rail 62 of U-shaped cross section having an outward opening side facing to the outside, two  
5 guide rods 621 ~~perpendicularly extended from the back sidewall of~~ connecting the vertical rail 62 to and the backboard 11 by ~~inserting~~ through respective guide holes 114 ~~of the backboard 11 and adapted to for guiding the vertical rail 62 to horizontally~~ movement of the vertical rail 62 ~~with the platform 52, a screw~~  
10 ~~rod~~ threaded rod 64 ~~longitudinally~~ vertically mounted in the vertical rail 62, a sliding pade 63 threaded onto the ~~screw~~ threaded rod 64 and moved along the vertical rail 62 as upon ~~rotating~~ ry motion of the screw ~~rod~~ threaded rod 64, and a limit switch 622 mounted in the vertical rail 62 ~~and adapted to limit~~  
15 ~~down~~ reduce an impact stroke of the sliding pade 63. The motor 65 ~~is controlled to rotates the screw~~ rod threaded rod 64 clockwise/counter-clockwise to thus move, causing the sliding pade 63 to be moved upwardlys/downwardlys along the vertical rail 62.

20 Referring to FIGS. 4 and 5 and FIG.1 again, a ~~cover~~ close/open control headstock gear mechanism 7 is provided disposed on a ~~at the backside of the backboard 11~~. The ~~cover~~ close/open control headstock gear mechanism 7 ~~comprises~~ has a

gate 71 fitting the access 110 of the backboard 11, ~~and a packing member~~ gasket 712 fastened ~~to the border~~ on edges of the gate 71 at a surface ~~110~~ not contacting the FOUP 8 ~~at the front side~~ and adapted to accommodate ~~match with~~ the cover 82 of the FOUP 8, 5

~~†The gate 71 comprising~~ has two front positioning pins 713 ~~adapted respectively to~~ engaged to the ~~recessed~~ positioning recesses ~~holes~~ 822 and 822' on the cover 82 of the FOUP 8 and to ~~prevent~~ stop the FOUP 8 from displacement and two through holes 711 corresponding to the lock ing holes 821 and 821' of the cover 10 82 of the FOUP 8. The headstock gear 7 also has two parallel racks 72 and 72' fixedly fastened on a ~~to the back sidewall of the gate 71 and arranged in parallel,~~ two support arms 73 and 73' respectively ~~forwardly extended from~~ disposed over the racks 72 and 72' below the gate 71 in order to ~~and inserted~~ through the 15 sliding slots 111 and 112 of the backboard 11 and fixedly connected to the sliding pade 63 of the ~~screw rod~~ threaded rod and slider set 61 of the lifting mechanism 6 for enabling the gate 71 to be moved ~~horizontally and vertically by~~ with the horizontal shifting mechanism 5 and the lifting mechanism 6, and a driving 20 unit 74 mounted on the back ~~sidewall~~ of the gate 71 and controlled to close/open the cover 82 of the FOUP 8. The driving unit 74 comprises ~~has~~ a transmission shaft 76, a motor 75 controlled to rotate the transmission shaft 76, two rotary bolts 77 and 77'

respectively coupled to the transmission shaft 76 and inserted through the through holes 711 of the gate 71 and ~~adapted for~~ engaging into the locking holes 821 and 821' of the cover 82 of the FOUP 8 to open the cover 82 from the opening 81 of the FOUP 8. Further, at least one, for example, two detectors 78 are ~~provided~~ disposed on at the topside of the gate 71. After ~~removal of opening~~ the cover 82 ~~from the opening 81 of the FOUP 8~~, the detectors 78 are moved with the gate 71 up and down relative to the FOUP 8 to detect ~~the wafer number and positioning of the wafers~~ in the FOUP 8. There ~~is also provided~~ In addition, a detector 79 is mounted on the back ~~sidewall~~ of the backboard 11 above the access 110, ~~and adapted~~ to detect ~~protrusion of~~ wafers in the FOUP 8, so as to prevent wafers from damage ~~when to the wafers upon~~ closing/opening of the cover 82.

As stated above, when the FOUP 8 is carried to the carriage ~~carrier~~ 2 by hand ~~labor~~ or an automatic truck, ~~the correct~~ positioning of the FOUP 8 is detected by the ~~upright detecting~~ on pins 202, ~~and 203~~ and 206, and then the ~~third upright detecting~~ on pin 206 is pressed down to start ~~turn on~~ the motor 31, ~~causing the~~ motor 31 to rotate the locking bolt 3 ~~in one direction through~~ by 90°, and therefore the locking bolt 31 is ~~forced into engaged~~ ment with the positioning portion ~~hole~~ 831 on the bottom panel ~~plate~~ 83 of the FOUP 8. At the same time, the motor 43 of the ~~clamp~~ latch

~~mechanism 4 is turned on to~~ rotates the screw rod threaded rod 44,  
to ~~move~~ causing the clamp latch locking plate 45 to be moved with  
the sliding pade 42 and ~~forced into engagement~~ with the retaining  
portion 831 of the bottom panel plate 83 of the FOUP 8. This  
5 double-locking effect ~~keeps~~ can ensure accurately forward  
movement of the FOUP 8 ~~in course~~. The sliding control mechanism  
21 ~~is then driven to moves~~ the earriage carrier 2 and the FOUP 8  
forwardly, causing the opening 81 of the FOUP 8 to be forced  
into close contact with the packing member gasket 113 of the  
10 access 110. Therefore, when the motor 75 of the driving unit 74 ~~is~~  
~~started to rotates~~ the rotary bolts 77 and 77' for opening the  
cover 82, the FOUP 8 is maintained free from contamination.  
Thereafter, the horizontal shifting mechanism 5 ~~is operated to~~  
moves the cover 82 horizontally and backwardly, and then the  
15 lifting mechanism 6 ~~is operated to lowers~~ the cover 82, for  
allowing the internal mechanical arm of the manufacturing  
equipment 9 to ~~pick up the~~ carry wafers from the FOUP 8. On the  
contrary, when closing the cover 82 on the FOUP 8, the ~~aforesaid~~  
procedure is repeated reversely. Therefore, the FOUP 8 can be  
20 automatically opened and closed in the manufacturing equipment 9  
without ~~causing~~ contamination.

Although the present invention has been explained in  
relation to its preferred embodiment, it is to be understood that



many other possible modifications and variations can be made without departing from the spirit and scope of the invention as hereinafter claimed.